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FROM FAILURE TO SUCCESS:
CONVERTING HIGH OCCUPANCY VEHICLE LANES TO HIGH OCCUPANCY TOLL LANES / EXPRESS TOLL LANES

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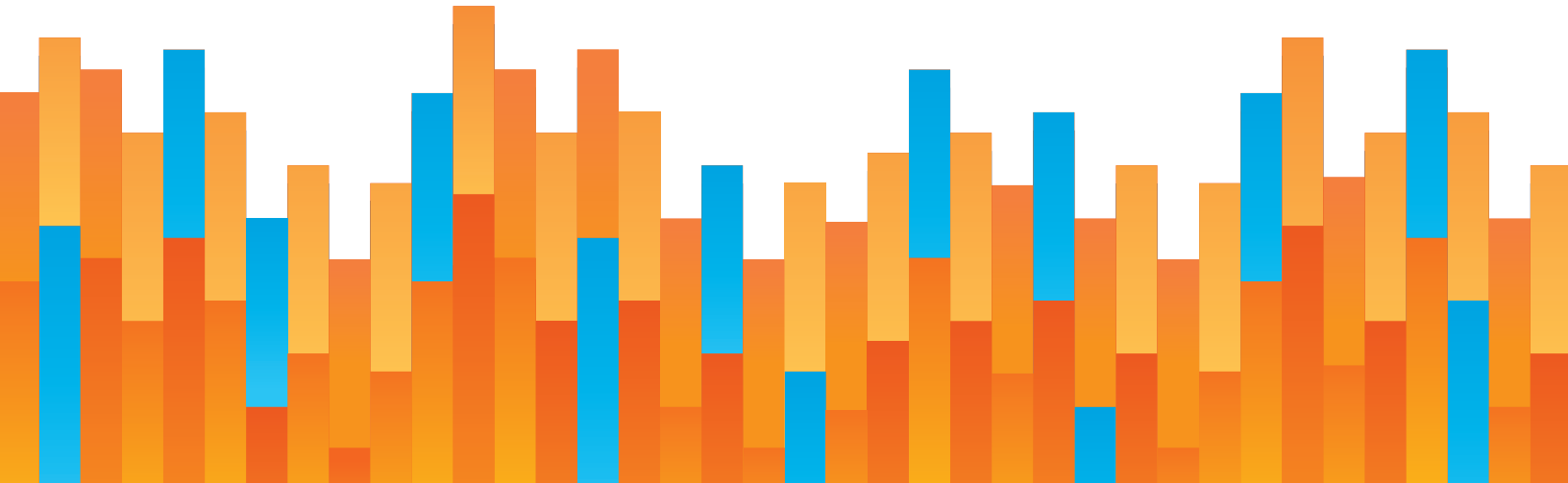

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TABLE OF CONTENTS

PART 1

INTRODUCTION

As COVID-19 becomes endemic and more Americans return to the office, vehicle-miles of travel per capita is reaching or exceeding its pre-COVID peak. As a result, traffic congestion is returning in many urban areas, particularly during afternoon peak periods.

While the recently passed $1.2 trillion Infrastructure Investment and Jobs Act (IIJA) provides some funding dedicated to reducing congestion, not every solution requires a multi-billion dollar highway expansion.[1] To improve traffic speeds, provide commuters a choice, and enhance bus service, state departments of transportation (DOTs) and local governments have been converting their high-occupancy vehicle (HOV) lanes into high-occupancy toll (HOT) lanes or express toll lanes (ETL). Despite more than two dozen conversions over the past 15 years, there are still 97 pure HOV lanes in operation.[2]

This brief examines why and how HOV lanes are converted, how much the conversions cost, and how HOT and ETLs have performed. It analyzes the advantages of HOT and ETL lanes compared with HOV lanes, and examines the political considerations of conversions. Finally, it lists the HOV lanes that could be converted to HOT/ETLs in the future.

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1 "AASHTO Comprehensive Analysis of the Bipartisan Infrastructure Bill," *policy.transportation.org*, American Association of State Highway and Transportation Officials, 15 Sep. 2021. https://policy.transportation.org/wp-content/uploads/sites/59/2021/09/2021-09-15-AASHTO-Comprehensive-Analysis-of-IIJA-FINAL.pdf (9 Feb. 2022).

2 "National Inventory of Specialty Lanes and Highways Technical Report," Federal Highway Administration Office of Operations, *ops.fhwa.dot.gov*, 28 May 2021. https://ops.fhwa.dot.gov/publications/fhwahop20043/ch3.htm (9 Feb. 2022).

Overall, the brief details why all HOV lanes should be converted to ETLs. However, in situations where it is not technically or politically realistic, it recognizes that a second-best alternative is to convert HOV lanes to HOT lanes.

PART 2

THE FAILURE OF HOV LANES

In order to understand why HOV lanes need to be converted, it helps to understand the reason why HOV lanes were created and just how badly HOV lanes have failed to meet their goals. In the early 1970s, a combination of the energy crisis and growing urban highway congestion led federal transportation policymakers to encourage the construction of special-purpose lanes to reduce the number of single-occupancy vehicles. The first special lanes were bus-only lanes that were constructed in several metro areas, including Los Angeles and Washington, D.C.[3] However, these lanes failed to accomplish policymakers' objective of increasing transit use for two different reasons. First, buses operating on these highways weren't of sufficient number to justify a dedicated lane. Second, as oil and automobile prices declined and household incomes increased, fewer Americans rode buses.

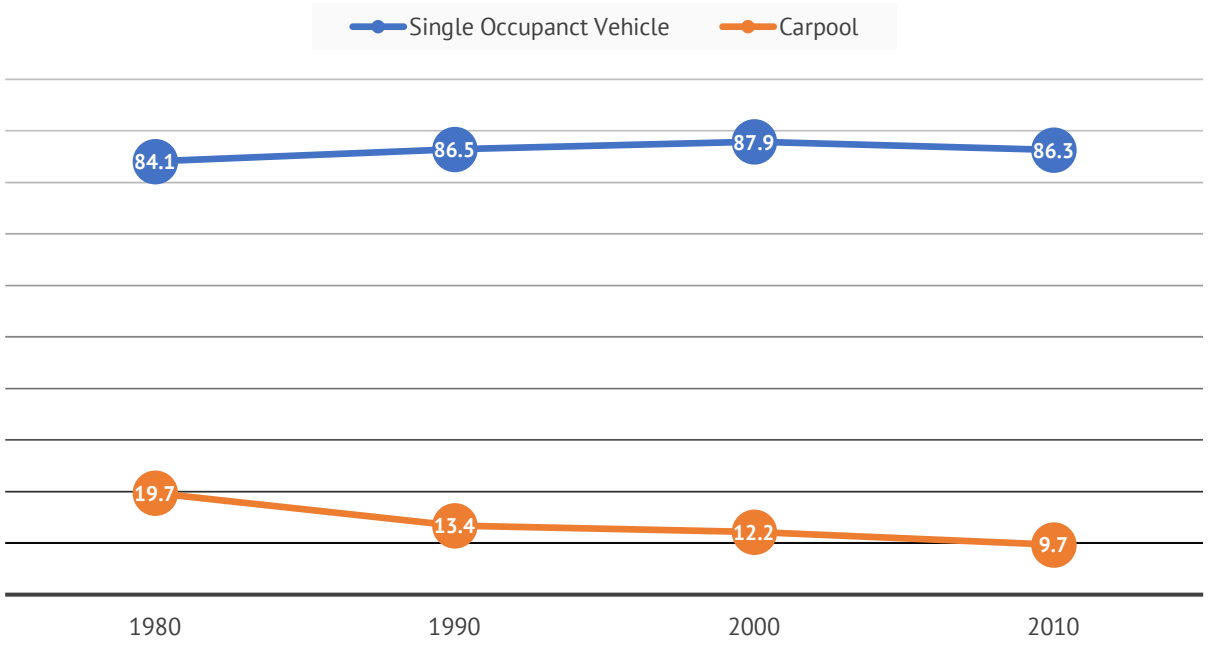
In the 1980s, busways were converted to high-occupancy vehicle (HOV) lanes (which allowed both carpools and buses to use the lane but without providing priority for the buses), and many new HOV lanes were built.[4] Originally, drivers had to have four or more people in their vehicle in order to use the HOV lanes. But since very few drivers were able

[3] Robert Poole and Ted Balaker, "Virtual Exclusive Busways Improving Urban Transit while Relieving Congestion," Reason Foundation, Sep. 2005. https://reason.org/wp-content/uploads/files/f74f4436cd5e98624899baf1c02c384f.pdf, (28 Apr. 2021).

[4] Ibid.

to find three additional passengers, HOV lane operators decreased the occupancy requirement to three or more people, and then to two or more people.[5] But even HOV lanes with a two-person minimum occupancy requirement failed to incentivize carpool formation. Over the last 50 years, the percentage of commuters carpooling has declined by more than 50%.[6] Figure 1 shows the large percentage decline in carpools and smaller percentage increase in single-occupant vehicles used for commuting.

FIGURE 1: PERCENT OF CARPOOLS: PERCENT COMMUTING BY SINGLE-OCCUPANT VEHICLE AND CARPOOL



Source: U.S. Census, American FactFinder

Analysts have speculated why carpooling has declined. There is no shortage of reasons. Population and employment have become more dispersed, with the majority of

5 Noreen McDonald and Robert Nolan, "Simulated Travel Impacts of High-Occupancy Vehicle Conversion Alternatives," Transportation Research Record 1765, *mcdonald.web.unc.edu*, Jan. 2013, https://mcdonald.web.unc.edu/wp-content/uploads/sites/8583/2014/12/McDonald_Noland_HOV_TRR2001.pdf (17 Mar. 2022),

Ginger Gooden et. al., "The Role of Preferential Treatment for Carpools in Managed Lanes," Texas A&M Transportation Institute, *static.tti.tamu.edu*, June 2009. https://static.tti.tamu.edu/tti.tamu.edu/documents/0-5286-2.pdf (18 Mar. 2022).

6 Sabrina Tavernise and Robert Gebeloff, "Once Popular, Car Pools Go the Way of Hitchiking," *The New York Times*, 28 Jan. 2011. https://www.nytimes.com/2011/01/29/us/29carpool.html (28 Apr. 2021).

employment now in suburban locations.[7] Automobile prices have declined in real terms (pandemic-era price inflation notwithstanding), and the majority of Americans prefer to commute by themselves, rather than with another person.[8] Trip-chaining (doing multiple activities in a row) has increased, especially among parents.[9] More employers are offering flexible work schedules, allowing employees to start working before 8 am or after 5:30 pm.[10] The workforce is aging, and carpooling is more popular among younger workers.[11] In addition, parking is typically subsidized, incentivizing employees to commute alone.[12] Further, the types of jobs with the highest carpool share, such as manufacturing, have declined in number.[13] Most recently, the outbreak of COVID-19 caused the share of employees working from home to more than double, reducing the potential pool of carpoolers.[14] While overall vehicles-miles traveled (VMT) has increased past its pre-COVID-19 number, VMT for commuting remains below its peak.

Because of changing employment and traffic patterns and declining carpooling, it is difficult to match commuters' demand with HOV lanes' supply. As a result, most HOV lanes

7 Emily Badger and Quoctrung Bui, "The Downtown Office District was Vulnerable Even Before Covid," *nytimes.com*, The New York Times, 7 July 2021. https://www.nytimes.com/interactive/2021/07/07/upshot/downtown-office-vulnerable-even-before-covid.html (9 Feb. 2022).

8 "New Scoop Research Reveals that 62% of Americans Did Not Apply for a Job Because of the Commute," *globenewswire.com*, Intrado Globenewswire, 24 Sep. 2019. https://www.globenewswire.com/news-release/2019/09/24/1919983/0/en/New-Scoop-Research-Reveals-That-62-of-Americans-Did-Not-Apply-for-a-Job-Because-of-the-Commute.html, (28 Apr. 2021).

9 Nancy McGuckin and Elaine Murakami, "Examining Trip-Chaining Behavior: A Comparison of Travel by Men and Women," citeseerx.ist.psu.edu, Penn State University, 2022. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.359.9067&rep=rep1&type=pdf (20 Mar. 2022).

10 Paul Davidson, "More Employers Offer Flexible Hours But Many Grapple with How to Make it Succeed," *USA Today*, 20 Oct. 2019. *usatoday.com*, https://www.usatoday.com/story/money/2019/10/20/flexible-hours-jobs-more-firms-offer-variable-schedules/4020990002/ (20 Mar. 2022).

11 Brian McKenzie, "Who Drives to Work? Commuting by Automobile in the United States: 2013, United States Census Bureau, *census.gov*, Aug. 2015. https://www.census.gov/content/dam/Census/library/publications/2015/acs/acs-32.pdf (20 Mar. 2022).

12 Richard Wilson and Donald Shoup, Parking Subsidies and Travel Choices: Assessing the Evidence, *Transportation* 17, (1990) 141-157. *University of California Los Angeles*, https://www.lewis.ucla.edu/wp-content/uploads/sites/10/2016/01/Willson-and-Shoup-1990.pdf (20 Mar. 2022).

13 Steve Polzin, "The Decline of Carpooling—Can App-Based Carpooling Reverse the Trend?" *planetizen.com*, Planetizen, 25 Feb. 2015. https://www.planetizen.com/node/74522/decline-carpooling—can-app-based-carpooling-reverse-trend (28 Apr. 2021).

14 Ayodele Faiyetole, Impact of COVID-19 on Willingness to Share Trips," *Transportation Research Interdisciplinary Perspectives 19* (2022), *Elsevier*, https://reader.elsevier.com/reader/sd/pii/S2590198222000082?token=1AA7C1B88305A8A2E2B5010B5AF87E768515C9ECF99CF2017EF9EEAEDBD9707F250AD5DD737A7F363110FD74CBDC0CBD&originRegion=us-east-1&originCreation=20220320190330 (20 Mar. 2022).

suffer from the "Goldilocks Phenomenon" of being either "too hot" (too many drivers using the lane, causing traffic speeds to decrease below the minimum speed limit) or too cold (too few drivers using the lane, causing valuable infrastructure to be wasted). "Too hot" HOV lanes do nothing to promote bus transit, because the buses are stuck in the same stop-and-go traffic as the carpools. "Too cold" HOV lanes limit support for managed lanes as a whole (HOV, HOT, ETL) because drivers in the general-purpose lanes become upset that adjacent lane capacity is underused and oppose the construction of or conversion to new special-purpose lanes.

But the biggest problem with HOV lanes is that they are not even effective at their primary job of encouraging the formation of carpools. Researchers have found that about half of HOV lane users are "fam-pools," or members of a family who are traveling someplace together. Another 25% of HOV lane users are commuters who would have traveled together regardless of carpool priority because they live and work in close proximity to each other. Therefore, only about 25% of lane users carpool because of the HOV requirement.[15]

> *"Depending on the facility, between 20% and 90% of HOV lane vehicles do not have the required minimum number of occupants."*

And these numbers don't take into account HOV lane violators. Depending on the facility, between 20% and 90% of HOV lane vehicles do not have the required minimum number of occupants.[16] Enforcing HOV lane occupancy minimums is often a low priority of police. Even when it is a priority, penalties are often a weak deterrent (small fines or no points on a driving record) and the number of violators so high that police cannot catch all of them. With HOT lanes all drivers can legally use the lanes, so there are fewer violators.

15 Randall Guensler, "HOV to HOT Conversion Impacts on Carpooling," http://nctspm.gatech.edu, National Center for Transportation Systems Productivity and Management, 15 Dec. 2016. http://nctspm.gatech.edu/sites/default/files/u63/HOVtoHOTConversionImpactsonCarpooling_RandallGuensler.pdf (28 Apr. 2021).

16 Brad Templeton, "Car Cheats May be Helping Traffic; How HOV Lanes can Fail, *Forbes.com*, 6 Aug. 2019, https://www.forbes.com/sites/bradtempleton/2019/08/06/carpool-cheats-may-be-helping-traffic-how-hov-lanes-can-fail/?sh=67248ef53d5d, (28 Apr.2021),

Lee Rennick, "Transit U: Why HOV Lanes Don't Mean Much in Nashville," *williamsonsource.com*, Williamson Source, 10 Apr. 2018. https://williamsonsource.com/transit-u-hov-lanes-dont-mean-much-nashville/ (28 Apr. 2021).

America has experimented with HOV lanes for almost 50 years. Usage continues to decrease even as we build more lanes. But there are other types of managed lanes. Part 3 explains how pricing can help solve the Goldilocks phenomena of HOV lanes and expand mobility options in highway corridors.

PART 3

THE RISE OF HIGH OCCUPANCY TOLL LANES AND EXPRESS TOLL LANES

As a result of the declining number of carpools, HOV lanes began falling out of favor in the 1990s. Thanks to California's Public-Private Partnership (P3) law, Assembly Bill 680, in 1995 a private operator pioneered a new type of managed lane—ETLs—on State Route 91.[17] Unlike HOV lanes that use occupancy restrictions to manage congestion, ETLs use pricing. All automobile drivers, regardless of occupancy, pay a variable toll to use the lane. The toll rises and falls based on the level of congestion in the lane. Buses and registered vanpools are the only vehicles that can use the lane for free. While ETLs were limited at first, today there are more than two dozen facilities in California, Colorado, Florida, Georgia, Maryland, Texas, and Virginia.

When DOTs cannot convert HOV lanes to ETLs, either due to political opposition or a requirement that carpools or low-emission (electric vehicles, hybrids) receive priority on the

17 "SR 91 Express Lanes Orange County," Build America Bureau, *transportation.gov*, 9 Sep. 2014. https://www.transportation.gov/buildamerica/projects/project-highlights/sr-91-express-lanes-orange-county-ca (9 Feb. 2022).

highway, transportation agencies can choose a second-best option and convert their HOV lanes to high-occupancy toll (HOT) lanes.[18] In HOT lanes, drivers of single-occupant vehicles pay a toll while carpools, with either 2+ or 3+ people, travel free of charge. There are more than 30 HOT lane facilities in operation across the country. Combining HOT lanes and ETLs, there are more than 60 variably priced lane facilities on U.S. freeways.

While both HOT lanes and ETLs improve travel conditions for automobiles, vanpools, and buses, there are several advantages to ETLs. First, since HOT lanes have carpools, electric vehicles, and government vehicles that don't pay for use, pricing is less effective in managing demand than in ETL lanes. As a result, these lanes often feature higher prices per mile ($1.00 or more) or lower overall speeds. These lower overall speeds harm both single-occupant vehicle drivers and bus riders. In fact, during peak periods some Los Angeles and San Francisco Bay area HOT lanes do not allow paying customers to use the lane, negating the entire advantage of HOT lanes compared with HOV lanes.[19]

While ETLs are always the preference because they provide a long-term solution (growth in the corridor and/or changing commute patterns do not affect the viability of the lane), in some cases it is possible to convert HOV lanes to HOT lanes without raising the lane's occupancy.

While ETLs are always the preference because they provide a long-term solution (growth in the corridor and/or changing commute patterns do not affect the viability of the lane), in some cases it is possible to convert HOV lanes to HOT lanes without raising the lane's occupancy. A Texas A&M Transportation Institute paper published in the journal *Research in Transportation Economics* examined capacity and speed on three corridors before and after HOV2+ lanes were converted to HOT2+ lanes.[20] On I-394, in Minnesota, throughput

18 "Converting HOV lanes to HOT lanes," Federal Highway Administration, *fhwa.dot.gov,* 9 Feb. 2022. https://www.fhwa.dot.gov/policy/otps/vpqrrt/sec1.cfm (9 Feb. 2022).

19 Joe Rouse, Washington, D.C., 11 Jan. 2022. Interview in person.

20 Mark Burris et. al, "The Impact of HOT Lanes on Carpools," *Research in Transportation Economics 44 (2014), Research in Transportation Economics Online.* elseveir.com/locate/retrec (9 May 2022).

increased by 25%; average speed and travel time reliability increased as well.[21] The number of HOVs decreased, but that may be due to a continued nationwide decrease in carpooling. On the SR 167 HOT lanes in Washington State, the average speed increased substantially.[22] On the I-45 Gulf Freeway in Texas, the travel speeds remained constant while the overall person throughput increased by 50%. In addition, as travel patterns change, TXDOT continues to tweak the tolling algorithm leading to an increase in throughput of approximately 1% per quarter (every three months) without a decrease in speed.[23] Not all corridors will fare as well, but this study shows why HOT lanes are preferrable to HOV lanes.

Even when DOTs do not want to convert HOV lanes to HOT lanes or ETLs, they may not have a choice. Part 4 explains the federal requirement for converting underperforming lanes.

21 Ken Buckeye, "Performance Evaluation of I-394 MnPASS Express Lanes in Minnesota," *Transportation Research Record Journal of the Transportation Research Board (2012), Transportation Research Record Journal of the Transportation Research Board Online*. https://www.researchgate.net/publication/272718260 9 May 2022.

22 "SR 167 HOT Lanes Pilot Project Fourth Annual Performance Summary May 2008-April 2012," Washington State Department of Transportation, *wsdot.gov*, 2012. https://wsdot.wa.gov/sites/default/files/2021-10/SR167_AnnualPerformanceSummary_080812_web.pdf (9 May 2022).

23 "Houston Express Lanes Operations Summary," Texas A&M Transportation Institute, *tti.tamu.edu*, May 2019. 3-5.

PART 4

THE REQUIREMENT TO CONVERT UNDERPERFORMING HOV LANES

Federal rules are another reason for local operators of lanes with degraded performance to convert their HOV lanes to HOT lanes or ETLs. Operators of federal-grant-supported HOV lanes that fail to meet the requirement for the lanes to operate at 45 mph or more an average 90% of the peak hour travel time could be forced to pay back all of the federal funds used to build the lane.[24] It is much better for local operators to convert failing lanes proactively, than to pay back funding. Many state DOTs do not have the funds needed to pay back the federal government. These DOTs would have to take out loans, limiting the construction and maintenance projects needed in other areas of the state. Explaining that the conversion is, in part, a result of federal policy could also help reduce political backlash. The federal rule could also be used to provide political cover. Finally, the proven success of pricing can help build political support.

[24] "Federal-Aid Highway Program Guidance on High Occupancy Vehicle (HOV) Facility Lanes," Federal Highway Administration Freeway Management Program, *ops.fhwa.dot.gov*, Sep. 2016. https://ops.fhwa.dot.gov/freewaymgmt/hovguidance/chapter4.htm (24 Feb. 2022).

PART 5

HIGHWAY PRICING AND EFFECTIVE MANAGEMENT OF TRAFFIC DEMAND

The success of HOT lanes and ETLs shows how pricing can effectively manage demand. But this section explains why pricing is more successful than occupancy details. It explains the different types of pricing and what happens when pricing is used incorrectly.

Research finds that road pricing is the most effective way to manage demand.[25] In metro areas, roadway demand will often exceed capacity.[26] Adding general purpose lanes may be too expensive or encounter political opposition. By converting existing HOV lanes to express toll lanes, more vehicles and more people will be able to use the freeway. Further, from a financial and political perspective, it is easier to convert existing lanes than build new capacity.

25 "The Social Impacts of Road Pricing: Summary and Conclusions," *itf.oecd.org*, The International Transport Forum, 2018. https://www.itf-oecd.org/sites/default/files/docs/social-impacts-road-pricing.pdf (20 Mar. 2022).

26 Regina McElroy and Rich Taylor, "The Congestion Problem," Federal Highway Administration, *highways.dot.gov*, Jul/Aug. 2007. https://highways.dot.gov/public-roads/julaug-2007/congestion-problem (9 Feb. 2022).

There are multiple types of road pricing.[27] Toll roads typically use flat-rate pricing, in which certain classes of vehicles (cars, trucks) pay flat rates to use the facility. In contrast, HOT lanes and ETLs use variable prices, where the toll rate rises and falls based on the demand. Ideally, the price adjusts dynamically (in real time). Some facilities have peak pricing, in which the price rises and falls based on a fixed schedule.[28] Some dynamically priced facilities have rate ceilings, whereby the price is not allowed to rise above a certain level.[29]

“Time-of-day pricing does not allow for differences in traffic volumes due to special events, accidents, weather, or seasonal variation. As a result, time-of-day pricing is a one-size-fits-all approach that is far from ideal.”

Both time-of-day-based pricing and pricing with a rate ceiling have limitations. Time-of-day pricing does not allow for differences in traffic volumes due to special events, accidents, weather, or seasonal variation. As a result, time-of-day pricing is a one-size-fits-all approach that is far from ideal. For example, the ETLs on SR 91 in California become congested whenever there is an accident in the regular lanes because the toll rates are fixed by time of day.

Rate ceilings place an arbitrary cap on the highway, leading demand to exceed supply and causing the lane to become congested with traffic. Rate ceilings lead to some perverse incentives. For example, on the I-95 managed lanes in South Florida, northbound commuters who travel at 3:30 PM pay a higher toll rate for free-flow conditions than

27 “Road Pricing,” Federal Highway Administration, *fhwa.dot.gov*, 2022. https://www.fhwa.dot.gov/roadpricing/ (9 Feb. 2022).

28 “Priced Managed Lane Guide,” Federal Highway Administration, *fhwa.dot.gov*, 2022. https://ops.fhwa.dot.gov/publications/fhwahop13007/pmlg1_0.htm (9 Feb. 2022).

29 “Trying to Free Up 95 Express, FDOT Prices ‘Lexus Lanes” at Lamborghini Rates,” *WLRN*, WLRN, 28 Feb. 2014. https://www.wlrn.org/the-end-of-the-road/2014-02-28/trying-to-free-up-95-express-fdot-prices-lexus-lanes-at-lamborghini-rates (29 Apr. 2021).

commuters who travel at 5:30 PM pay for stop-and-go conditions.[30] This is due to a legislative mandate that requires the charge to be at the minimum rate if the lanes fail to meet the federal 45 mph standard. Yet this is precisely the time when the price needs to be at the maximum level, due to a bottleneck interchange where I-95 connects with the Florida Turnpike and Palmetto Expressway.

Pricing has proven to be more effective than occupancy restrictions in improving traffic flow. But it is important to establish basic operating rules to maximize mobility. Further, transitioning HOV lanes to HOT lanes or ETLs has conversion costs, for which agencies need to plan.

[30] Scott Calvert, "Why Not All Tolls Rise to Nearly $50," *Wall Street Journal*, 4 May 2018, wsj.com. https://www.wsj.com/articles/should-supply-and-demand-determine-the-price-for-a-fast-commute-1525426200 (29 Apr. 2021)

PART 6

CONVERSION COSTS/RULES

The cost to convert an HOV lane to a HOT lane or an ETL is minimal.[31] The Georgia Department of Transportation spent $80 million to convert 34 lane-miles of I-85 northeast of Atlanta from an HOV lane to a HOT lane. The agency added new signage that clearly explained the occupancy and any applicable time-of-day restrictions. Before the motorist chooses the HOT/ETL option, signs should display the price to use the lane, and when a motorist is in the lane, signs should display prices to exit at different locations.

> *"The cost to convert an HOV lane to a HOT lane or an ETL is minimal."*

Since HOT lanes and ETLs use open-road tolling with overhead gantries, customers use transponders (small window stickers that communicate with the tolling technology) to

[31] "Guidelines for Implementing Managed Lanes," Transportation Research Board, *nap.edu*, 2016. https://www.nap.edu/catalog/23660/guidelines-for-implementing-managed-lanes (9 Feb. 2022).

record when/how often a vehicle uses a lane.[32] For customers who sometimes travel in carpools and sometimes travel alone, a transponder with two settings (single-occupant and carpool) is available. Some toll-road operators allow drivers without a transponder to use the lanes for a higher price by recording the driver's license plate (termed pay-by-plate) and mailing the invoice to the driver or making it available to access online. (However, non-registered license plate bill-by-mail schemes have high collection costs and uncollected balances, particularly in corridors with a high percentage of out-of-state traffic).[33] Another alternative method of collecting payment is for a user to pay by smart phone app.

> *Enforcement is less of a concern with HOT lanes than HOV lanes.*

Enforcement is less of a concern with HOT lanes than HOV lanes. Since single-occupant vehicles can access the lane, there are fewer violators. However, some violations do occur. Traditionally, systems that did not allow pay-by-plate (described in the previous paragraph) sent a violation to drivers without a transponder and took legal action if a driver continued to use a HOT/ETL lane without a transponder. In systems with switchable transponders, some single-occupant vehicles will leave the transponder in carpool mode when traveling alone. Transurban, which operates Express Lanes on I-95, I-395, and I-495 in Northern Virginia is using fixed- and mobile-cameras to verify which vehicles have only one occupant and ensure that those drivers are paying a toll.[34] Minnesota State Police are using cameras that capture images of non-paying vehicles in the visible and infrared bands.[35] This

[32] "EZPass," Virginia Department of Transportation, *ezpasscva.com*, 2017. https://www.ezpassva.com (9 Feb. 2022).

[33] Jacob Barron, "IBTTA Annual Meeting Offers a Primer on Toll Leakage from the Lost Revenue Task Force," *ibtta.org*, International Bridge, Tunnel, and Turnpike Authority, 27 Oct. 2021. https://www.ibtta.org/blog/ibtta-annual-meeting-offers-%C2%A0primer-toll-leakage-lost-revenue-task-force (3 Mar. 2022).

[34] Luz Lazo, "HOV Cameras Are Being Deployed to Catch Toll Cheaters on 95, 395, and 495 Express Lanes," *The Washington Post*, 17 Nov. 2020, *Washingtonpost.com*. https://www.washingtonpost.com/transportation/2020/11/17/hov-cameras-are-being-deployed-catch-toll-cheaters-95-395-495-express-lanes/ (3 Mar. 2022).

[35] Nikolaos Papanikolopoulos, "Sensing for HOV/HOT Lanes Enforcement," Minnesota Department of Transportation, *dot.state.mn.us*, Feb. 2017. https://www.dot.state.mn.us/research/reports/2017/201705.pdf (3 Mar. 2022).

system helps to improve image quality, so there is no question how many people are in the vehicle.

It is also important to develop operating rules such as which types of vehicles can use the lanes at what times of day. Furthermore, policymakers must establish whether the lanes should be open access (drivers can switch from the general purpose lanes at all times) or closed access (drivers can switch at designated locations only). Since not all HOT lanes and ETLs are the same, policymakers should carefully consider the operating rules of their HOT lanes and ETLs.[36] The five considerations for authorities are summarized below:

- First, are carpools going to be allowed to use the lane without paying a toll, and if so, what is the minimum occupancy restriction?
- Second, will the lanes operate 24 hours per day or only during peak periods?
- Third, what will be the penalty for violators and how will the law be enforced?
- Fourth, will the lanes require a transponder or allow alternative payment methods? and
- Fifth, will the lanes be open (drivers can enter and exit at most any point from the adjoining general purpose lanes) or closed (entry and exit are allowed at certain locations only)?

Considering conversion costs and developing operating rules may seem trivial. But they can be the difference between a successful managed lane conversion and a failure. The following section details one of the biggest challenges of lane conversions: politics.

[36] "Priced Managed Lane Guide," Federal Highway Administration.

PART 7

POLITICAL CHALLENGES

Political risk may be the biggest reason why more HOV lanes have not been converted to HOT lanes or ETLs. Some HOV lanes have enough capacity to allow paying solo drivers to use the lane and not overload the lane.[37] These conversions are relatively easy because they improve the travel conditions of one group of travelers (solo drivers) without inconveniencing another group (carpoolers). However, converting the HOV lanes of other facilities and keeping the same occupancy requirement would overload the lane, causing speeds to drop below the federally mandated 45 mph 90% of the time, requiring a change in vehicle occupancy ("too hot" lanes). For example, on I-85 northeast of Atlanta the minimum HOV occupancy was increased from two to three.[38] Elected officials are more hesitant to make this change because, while it benefits one group of commuters (solo drivers, vanpools, buses, 3+person carpoolers), it inconveniences another group (2-person carpoolers). Elected officials did not win their office by inconveniencing voters.

However, elected officials should consider that in most cases, even when they need to raise the vehicle occupancy requirement, the number of people benefitting from the policy exceeds the number of people harmed by the policy. For example, on I-95 in South Florida,

[37] "Tolling and Pricing Program," Federal Highway Administration, *ops.fhwa.dot.gov*, 3 Dec. 2020. https://ops.fhwa.dot.gov/publications/fhwahop09029/sec1_introduction.htm (10 Feb. 2022).

[38] "Report on the Value Pricing Pilot Program Through April 2012," Federal Highway Administration Congestion Pricing, *ops.fhwa.dot.gov*, 11 Feb. 2022. https://ops.fhwa.dot.gov/congestionpricing/value_pricing/pubs_reports/rpttocongress/accelerating.htm (28 Feb. 2022).

the average commuter bus transports 40 people and the average vanpool transports seven people.[39] If four buses and 16 vanpools use the lane per hour, that is a total of 272 people that benefit from the change. In addition, solo drivers who could not use the HOV lane benefit from the change in policy. There are 1,000 solo-occupant vehicles who use the lane per hour with approximately 1.15 people per vehicle. As a result, 1,150 solo occupant drivers benefit from the change in policy, and 272 transit customers benefit for a total of 1,422 people. There are approximately 300 carpools per hour with an average occupancy of 2.2, for a total of 660 people who do not benefit. Therefore, more than twice as many people benefit as lose from the change in policy.

> *…elected officials should consider that in most cases, even when they need to raise the vehicle occupancy requirement, the number of people benefitting from the policy exceeds the number of people harmed by the policy.*

[39] "Transit Capacity and Quality of Service Manual," Transportation Research Board *onlinepubs.trb.org*, 2017. https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdo;;c_6-b.pdf (10 Feb. 2022).

PART 8

CONCLUSION AND RECOMMENDATIONS

8.1 CONCLUSION

COVID-19 further reduced carpooling in the U.S., which has been dropping for the past 50 years. Outside of selected corridors in the most congested metro areas, HOV lanes have been a failure. The creation of HOT lanes and ETLs 25 years ago provided a way to improve mobility for more commuters. Instead of rewarding the 75% of carpoolers who would have ridden together without the HOV lane, HOT lanes and ETLs reward vanpoolers and bus riders who made a conscious decision to travel together. Converting HOV lanes to HOT lanes and ETLs reduces congestion in the lane. Further, drivers of single-occupant vehicles can use the lane, providing all drivers with an option of a congestion-free commute. And the toll revenue funds the conversion of the lane.

While many HOV lanes have been converted to HOT lanes or ETLs, there are still 97 HOV lane facilities in operation.[40] State DOTs need to convert all remaining HOV lanes to HOT lanes or ETLs. Converting HOV lanes to ETL is preferred because, without carpools in the lanes, pricing can be more effective at managing congestion. However, converting HOV

[40] "National Inventory of Specialty Lanes and Highways Technical Report," Federal Highway Administration Office of Operations.

lanes to ETLs may not be politically feasible in situations where it requires displacing a large number of carpools. In these situations, HOV lanes should be converted to HOT lanes.

> *… drivers of single-occupant vehicles can use the lane, providing all drivers with an option of a congestion-free commute. And the toll revenue funds the conversion of the lane.*

8.2 POLICY AND POLITICAL RECOMMENDATIONS

There are several steps in converting HOV lanes to HOT lanes or ETLs. The first step is to admit that HOV lanes have failed to raise vehicle occupancy. In fact, since HOV lanes were first enacted the percent of carpools has declined more than 50%. The second step is for operators with HOV lanes with excess capacity to convert those lanes since there is no need to raise occupancy minimums. Converting these lanes will increase driver support for future conversions. After HOV lanes with excess capacity are converted, the third step is for tollroad agencies to convert HOV lanes with degraded performance, in a two-step process. First increase the occupancy requirement. For HOT lanes this means increasing the minimum number of people required in the carpool to use the lane. For ETLs this means allowing only vanpools and buses to use the lane free of charge. Second, allow vehicles that do not meet the new occupancy requirement to use the lane by paying a toll. When officials in Georgia tried to make both pricing and occupancy changes at once, it was both confusing to motorists and challenging for toll road officials to set the correct pricing algorithm. As a result, the I-85 HOT lane northeast of Atlanta was initially very unpopular.[41] (After adjusting the algorithm and expanding public outreach, the popularity of the I-85 lane increased). As a result of the Georgia experience, Virginia officials decided to implement tolling and raise the occupancy of the I-66 inside-the-beltway HOT lanes in two successive steps, increasing popular support and reducing political grandstanding.[42]

41 "SmartMove," *ibtta.org*, International Bridge Tunnel and Turnpike Association, 2021. https://www.ibtta.org/sites/default/files/documents/MAF/Success%20Story_State%20Road%20Toll%20Authority.pdf (29 Apr. 2021).

42 "66 Express Lanes Inside the Beltway," Virginia Department of Transportation, *66expresslanes.org*, 2022. http://66expresslanes.org/about_the_lanes/default.asp (3 Mar. 2022).

If policymakers take a step-by-step approach to converting the lanes, political opposition can be minimized. It is past time for the 97 HOV lane facilities with 2,897 lane-miles in operation to be converted to HOT or ETLs. Table 1 details each of these 97 remaining HOV-lane facilities that could be converted to HOT or ETL Lanes.

TABLE 1: DETAILED LIST OF HOV LANE FACILITIES THAT COULD BE CONVERTED

State	County	Route Number	Route Name	Operator	Lane-Miles
AZ	Maricopa	SR-202	Loop 202 (Santan Freeway)	Arizona Department of Transportation	21.35
AZ	Maricopa	SR-51	SR-51 (Piestewa Freeway)	Arizona Department of Transportation	31.84
AZ	Maricopa	US-60	US-60 (Superstition Freeway)	Arizona Department of Transportation	40.25
AZ	Maricopa	I-17	I-17 HOV Lanes	Arizona Department of Transportation	44.27
AZ	Maricopa	SR-202	Loop 202 (Red Mountain Freeway)	Arizona Department of Transportation	57.08
AZ	Maricopa	I-10	I-10	Arizona Department of Transportation	75.84
AZ	Maricopa	Loop 101	Loop 101	Arizona Department of Transportation	119.42
CA	Alameda	SR-84	SR-84 (WB)	California Department of Transportation	3
CA	Alameda	SR-92	SR-92 (WB)	California Department of Transportation	3
CA	Los Angeles	SR-170	SR-170	California Department of Transportation	12.8
CA	Los Angeles	I-10	I-10	California Department of Transportation	3.4
CA	Contra Costa	I-680	I-680	California Department of Transportation	25
CA	San Bernardino	SR-71	SR-71	California Department of Transportation	16.2
CA	San Diego	I-805	I-805	California Department of Transportation	18
CA	Santa Clara	SR-87	SR-87	California Department of Transportation	18.2
CA	Santa Clara	I-280	I-280	California Department of Transportation	21
CA	Orange	SR-55	SR-55	California Department of Transportation	21.4
CA	Riverside	SR-91	SR-91 (Riverside County East)	California Department of Transportation	27.4
CA	Los Angeles	SR-118	SR-118	California Department of Transportation	23.4
CA	Riverside, San Bernardino	I-215	I-215	California Department of Transportation	24

State	County	Route Number	Route Name	Operator	Lane-Miles
CA	Los Angeles	SR-22	SR-22	California Department of Transportation	24
CA	Los Angeles	SR-134	SR-134	California Department of Transportation	26.6
CA	Sacramento	SR-99	SR-99	California Department of Transportation	27.4
CA	Los Angeles, San Bernardino	I-10	I-10	California Department of Transportation	29
CA	Contra Costa	SR-4	SR-4	California Department of Transportation	30
CA	Los Angeles	I-105	I-105	California Department of Transportation	33
CA	Los Angeles, Orange	SR-57	SR-57 (Los Angeles County, Orange County)	California Department of Transportation	33.4
CA	Los Angeles	I-5	I-5 North (Los Angeles County)	California Department of Transportation	25.1
CA	Marin	US-101	US-101 (Marin County)	California Department of Transportation	37.2
CA	San Diego	I-5	I-5 San Diego	California Department of Transportation	37.1
CA	Sacramento, Placer	I-80	I-80 (Sacramento County, Placer County)	California Department of Transportation	43
CA	Sonoma	US-101	US-101 (Sonoma County)	California Department of Transportation	44.2
CA	Los Angeles, Orange	I-605	I-605	California Department of Transportation	45
CA	Alameda, Contra Costa	I-80	I-80 (Alameda County, Contra Costa)	California Department of Transportation	46
CA	Santa Clara	SR-85	SR-85	California Department of Transportation	52
CA	Sacramento, El Dorado	US-50	US-50 (Sacramento County, El Dorado County)	California Department of Transportation	52.2
CA	Orange, Los Angeles	SR-91	SR-91 (Los Angeles County, Orange County)	California Department of Transportation	54
CA	Alameda	I-880	I-880	California Department of Transportation	62
CA	Los Angeles	SR-14	SR-14	California Department of Transportation	72
CA	San Mateo, Santa Clara	US-101	US-101 (San Mateo County, Santa Clara County)	California Department of Transportation	83.4
CA	Orange	I-5	I-5 (Orange County)	California Department of Transportation	85.4
CA	Los Angeles, San Bernardino	I-210, SR-210	I-210/SR-210	California Department of Transportation	96.8
CA	Los Angeles, Riverside, San Bernardino, Riverside	SR-60	SR-60 (Los Angeles County, San Bernardino County, Riverside County)	California Department of Transportation	105.6
CA	Los Angeles	I-405	I-405 HOV Lanes	California Department of Transportation	146

State	County	Route Number	Route Name	Operator	Lane-Miles
CO	Denver	US-85	US-85 (Sante Fe Drive)	Colorado Department of Transportation	16
CO	Pitkin	SH-82	SH-82	Colorado Department of Transportation	30
CT	Hartford	CT-2	CT-2	Connecticut Department of Transportation	0.5
CT	Hartford	I-384	I-384	Connecticut Department of Transportation	3.34
CT	Hartford	I-91	I-91	Connecticut Department of Transportation	15.15
CT	Hartford	I-84	I-84	Connecticut Department of Transportation	18.83
GA	Fulton, DeKalb	I-20	I-20	Georgia Department of Transportation	16.4
GA	Fulton, DeKalb	I-85	I-85	Georgia Department of Transportation	18.8
GA	Fulton	I-75	I-75	Georgia Department of Transportation	38.8
HI	Honolulu	92	Keehi Interchange to Industrial Parkway (EB)	Hawaii Department of Transportation	1.74
HI	Honolulu	H-201	Halawa Interchange to Puuloa Road	Hawaii Department of Transportation	2.4
HI	Honolulu	H-2	Interstate Route H-2	Hawaii Department of Transportation	9.78
HI	Honolulu	H-1	Interstate Route H-1 Eastbound (Zip Lane)	Hawaii Department of Transportation	18.03
HI	Honolulu	H-1	Interstate Route H-1 (EB and WB)	Hawaii Department of Transportation	17.52
LA	Jefferson, Orleans	US-90	US-90 Business	Louisiana Department of Transportation and Development	1.14
MA	Suffolk	I-93	I-93 North	Massachusetts Department of Transportation	2.6
MA	Norfolk	I-93	Southeast Expressway	Massachusetts Department of Transportation	5.4
MD	Prince George	I-595	John Hanson Highway	Maryland Department of Transportation	15
MD	Montgomery	I-270	I-270	Maryland Department of Transportation	27.7
NJ	Hudson	I-95	New Jersey Turnpike	New Jersey Turnpike Authority	1
NJ	Middlesex, Union, Essex	I-95	New Jersey Turnpike (near George Washington Bridge)	New Jersey Turnpike Authority	26
NV	Las Vegas	I-15	I-15	Nevada Department of Transportation	20
NV	Clark, Las Vegas	US-95	US-95 Northwest Corridor	Nevada Department of Transportation	24
NY	Richmond	I-278	Gowanus Expressway	New York City Department of Transportation	6

State	County	Route Number	Route Name	Operator	Lane-Miles
NY	Suffolk, Nassau Counties	I-495	Long Island Expressway	New York State Department of Transportation	80
NY	New York	NA	Manhattan Bridge	New York City Department of Transportation	1.2
NY	New York, Queens	NY-25	Ed Koch Queensboro Bridge	New York City Department of Transportation	2.8
NY	Queens	I-495	Long Island Expressway	New York City Department of Transportation	3.3
NY	Richmond	I-278	Staten Island Expressway	New York State Department of Transportation	8.4
OR	Multnomah	I-5	I-5	Oregon Department of Transportation	3.5
PA	Allegheny	I-279, I-579	I-279, I-579	Pennsylvania Department of Transportation	10.6
TN	Shelby	I-55	I-55 Memphis	Tennessee Department of Transportation	10.1
TN	Davidson	I-65	I-65 Nashville	Tennessee Department of Transportation	12.13
TN	Shelby	I-40	I-40 Memphis	Tennessee Department of Transportation	13.19
TN	Davidson, Wilson	I-40	I-40 Nashville	Tennessee Department of Transportation	33.74
TN	Williamson, Davidson	I-65	I-65 Nashville	Tennessee Department of Transportation	36.19
TN	Davidson, Rutherford	I-24	I-24 Nashville	Tennessee Department of Transportation	50.16
TX	Harris	I-10	Katy Freeway	Metropolitan Transit Authority of Harris County	24.8
TX	Montgomery	US-59, I-69	US 59 Southwest Freeway	Metropolitan Transit Authority of Harris County	9.7
TX	Dallas	I-30	I-30 (East R.L. Thornton Freeway)	Texas Department of Transportation	11.1
TX	Dallas, Collin	US-75	US-75	Texas Department of Transportation	40
VA	Norfolk	I-564	I-564	Virginia Department of Transportation	3.75
VA	Norfolk	I-64	I-64 Norfolk	Virginia Department of Transportation	12
VA	Virginia Beach, Norfolk	I-264	I-264	Virginia Department of Transportation	16
VA	Norfolk	I-64	I-64 Hampton Roads and Newport News	Virginia Department of Transportation	20
VA	Reston	SR-267	Dulles Toll Road	Metropolitan Washington Airports Authority	10
VA	Fairfax	I-66	I-66 Outside Beltway	Virginia Department of Transportation	44
WA	King	SR-520	SR-520	Washington State Department of Transportation	16

State	County	Route Number	Route Name	Operator	Lane-Miles
WA	Pierce	SR-16	SR-16	Washington State Department of Transportation	20
WA	King	I-405	I-405	Washington State Department of Transportation	24.8
WA	King	I-90	I-90	Washington State Department of Transportation	30
WA	Snohomish, King	I-5	I-5	Washington State Department of Transportation	33.4
WA	Snohomish, King, Pierce	I-5	I-5, Fife to Mercer Island	Washington State Department of Transportation	58.4

Source: Adapted from FHWA National Inventory of Specialty Lanes and Highways: Technical Report, Chapter 3. Inventory of Specialty Lanes and Highways, Table 8 High Occupancy Vehicle Facilities by State

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